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Modern Concepts of Cardiovascular Disease

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EXTREME CARDIAC ENLARGEMENT

In the normal adult the heart weight constitutes from .35 to .50 per cent of the body weight and is proportionate to the skeletal muscle development. This is one factor for higher values in men and thin persons as compared with the weight of the heart in women and obese individuals. The range of weight of the normal adult heart is from 200 to 375 grams, the average in the male being approximately 300 grams and in the female 250 grams. In large muscular persons the heart weight may exceed the upper limit of the normal range without clinical evidence of cardiac abnormality.

Enlargement of the heart affected directly by intrinsic disease or indirectly by changes in other organs is a compensatory response and may be due to hypertrophy, dilatation or both. A combination of hypertrophy and dilatation of varying degrees is much more often obtained than either condition existing alone. Enlargement due predominantly to hypertrophy is referred to as concentric; when marked dilatation co-exists, the enlargement is said to be eccentric. Hypertrophy, or increased bulk of the heart muscle, chiefly ventricular, is not associated with a multiplication of the muscle fibres, but is due to an increase of the thickness or size of each fibre.

Some degree of dilatation almost always precedes the development of hypertrophy. The permanent lengthening of the muscle fibres tends to reduce the heart's capacity for work since the fibres tend to approach their point of greatest extension. The hypertrophy which follows results in an increase in the power of the muscle fibres at their new length, thus raising the heart's reserve power. The manner in which increase in fibre length brings about the over-

growth is not definitely known. It has been suggested that there occurs an elevation of muscle metabolism consequent upon lengthening or dilatation. This view is in accord with the fact that a diseased myocardium may hypertrophy even though its work is not at all increased and that a marked increase in the work of healthy heart muscle is associated with only a moderate degree of overgrowth.

An increase in the mass of the heart out of proportion to the individual's skeletal musculature occurs under two general conditions; namely, when the work which a cardiac chamber performs is definitely increased and when the functional capacity of the myocardium is impaired as by inflammatory and degenerative changes. Very often an increase of the work which the heart is called upon to perform and myocardial damage are combined in producing dilatation and hypertrophy. This combination, as we shall see, gives rise frequently to the largest hearts.

The most common causes of heart strain with resulting enlargement are hypertension and valvular disease. Less frequent causes are coronary disease with myocardial degeneration and infarction, true myocarditis especially that associated with the rheumatic infection, chronic pulmonary disease, thyrotoxicosis, and pericarditis with adhesions to the surrounding thoracic structure (chronic mediastino-pericarditis). Of lesser frequency as factors resulting in heart enlargement are deformity of the thorax and spine, arteriovenous aneurysms, severe anemia, beriberi, myxedema, and cardiac tumors. There are, in addition, instances of cardiac enlargement of unknown etiology, so-called idiopathic hypertrophy. Evidently there are factors of cardiac strain still unknown or not recognizable with

IMPORTANT NOTICE

The Fourteenth Scientific Meeting of the American Heart Association will be held at Hotel Jefferson, St. Louis, Missouri. The general cardiac program will be given on Friday, May 12, and the program of the Section for the Study of the Peripheral Circulation on Saturday, May 13.

Admission to meetings will be free to all 1939 *paid-up* members.

To *non-members*, a registration fee of \$2.00 will be charged.

present-day methods of clinical investigation.

Hearts which weigh more than 600 grams are frequently encountered at necropsy and are generally considered to be markedly enlarged. The clinical records and necropsy findings of a group of 305 patients with such markedly hypertrophied hearts were studied by the authors several years ago. Fifty-seven per cent of the patients were white. Only forty-three or fifteen per cent were female. This is in accord with the reports of other observers that cardiac enlargement is common in both sexes, but that the largest hearts are more frequently found in men. The range of incidence from the point of view of age was from 30 to 70 years; the greatest number occurring during the fifth decade. Sixteen of the patients were under 30 years and six were beyond eighty. The heaviest hearts were obtained from persons between 40 and 70 years. While it is generally true that hypertrophy develops more rapidly and that hearts attain a greater mass in the young, yet enormous hearts may develop after middle life. The most frequent predominant factors producing heart strain and marked cardiac hypertrophy in this group of 305 persons were hypertension, both essential and associated with renal disease, and aortic regurgitation of syphilitic origin. It must of course be borne in mind that almost half of the patients were colored in whom syphilis and hypertension are common, the latter commencing earlier in life than in the white. Of lesser frequency and in order of incidence as causes for heart enlargement were chronic valvular disease of rheumatic origin, particularly combined mitral and aortic disease, chronic pericarditis with adhesions to neighboring structures, and congenital defects. In almost all instances there were multiple factors responsible for the marked heart enlargement. The most frequent secondary element was coronary sclerosis with myocardial degeneration or fibrosis.

Hearts weighing more than 1000 grams are not commonly encountered but they are not rare. Nine of the group of patients described above had hearts of such enormous mass, the heaviest being 1475 grams. A search of the literature of the past century yielded only 38 reports of patients with similar extremely enlarged hearts. This relative infrequency is probably due to the fact that mention of them was made only incidentally in case reports and as such are difficult to locate. The largest heart on record was removed from a middle-aged man and was said to have weighed five pounds. The specimen has been lost and no information regarding it or the patient is obtainable from the curator of the museum in which it was reported to have been placed. Another instance of *cor bovinum* was reported by Stokes in 1869 in a 25-year-old male. The heart weighed 1980 grams and exhibited a deformed aortic valve with aortic regurgitation; pericarditis was present, but there were no adhesions to the surrounding thoracic structures. A heart weighing 1755 grams was reported by Smith in 1850. It was present in a 28-year-old boy. The predominant factors of cardiac

strain were pericarditis with external adhesions and deformities of the aortic and mitral valves.

Of the group of 38 patients reported in the literature, only one was a female. Twenty-two were under 40 years of age. Two-thirds of our group of nine were above 40 years of age, one was female, and five were colored. The age and racial difference of the groups accounts for the relatively greater incidence of syphilitic aortic regurgitation and hypertension as causes of extreme heart hypertrophy in the group of nine, in contrast with the much higher occurrence of rheumatic pericardial and valvular changes in the younger group obtained from the literature. The largest specimens of the latter series exhibited a combination of aortic regurgitation and pericardial adhesions.

Marked cardiac enlargement per se is not responsible for any symptom or group of distinctive symptoms. In most cases, varying degrees of cardiac insufficiency have been present for years with the patient either almost completely incapacitated or confined to bed by increasingly frequent and prolonged periods of heart failure. Termination with uremia rather than congestive heart failure alone is not infrequent in patients with hypertension and renal disease.

Physical examination may yield significant signs suggesting the existence of marked cardiac enlargement. These include the downward dislocation of the apex beat in the axilla, the presence of diffuse heaving pulsation of the anterior chest wall, an extremely large area of cardiac dullness, and the signs of adhesive pericarditis. An enormously large heart may produce systolic retraction of the intercostal spaces synchronous with each cardiac contraction. The co-existence of aortic regurgitation with marked hypertension should imply a markedly hypertrophied heart.

Roentgen ray studies furnish valuable information as to the size of the heart. Two conditions may require differentiation; pericardial effusion and cardiac tumor. With pericardial effusion there occurs a characteristic change in the heart shadow, the latter being globular in the recumbent position and pear-shaped or "water-bottle" in contour in the upright position. Cardiac pulsations may diminish or disappear with large pericardial effusions. Cardiac tumors are more difficult to differentiate except by localized absence of the pulsations as observed fluoroscopically. It is also important to remember that the area of cardiac dullness or the location of the apex beat on palpation may appear to be displaced outward much more than is apparent on roentgenological examination. This is usually due to the fact that palpation and percussion are usually performed with the patient in the supine position while roentgenological examination is usually done in the upright position at which time descent of the diaphragm is an important factor.

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